PLANT KINGDOM

(1) Artificial Classification System.

By linnaeus

Earleest classification system.

Uses → only → Gross superficial morphogical characters

- habitat
- colour
- number & shape of leaves

Based on → mainly → Vegetative characters / Androecium Structure

Drawbacks : The seperated closely related species, bcz they were based on few characteristic.

This given equal weightage to vegetative & sexual characteristics, but this is not acceptable as veg. characters are more easily affected by environment.

(2) Natural Classification System

By George Bentham & Joseph Dalton Hooker

Based on → natural affinities among the organism

Consider not only external feature, but also the internal features

Given for flowering plants

- (1) External
- (2) Ultrastructure
- (3) Anatomy
- (4) Embryology
- (5) Phytochemistry

(UP) U Pea

- Embryology
- Anatomy
- ultrastr.
- Phytochem.

At present,

(3) Phylogenetic Classification System.

Based on → evolutionary relationships b/w various organisms

Assumption: Organisms belonging to the same taxa have a common ancestor.

We now use information from many other sources too to help resolve difficulties in classification. These become more important when there is no supporting fossil evidence.

- **Numerical Taxonomy**: Carried out using computers
  Based on → All observable characteristic.
  Number & codes to all characters
  ↓ then
  Data is processed.
  Hence, each character is given equal imp.
  & at same time hundreds of characters are considered.

chromosome
↑
(Cyto)-chrome

- **Cytotaxonomy**: Based on → Cytological information
  - → Chromosome number
  - → chromosome structure
  - → Chromosome behaviour

- **Chemotaxonomy**: Uses chemical constituents of the plant to resolve confusion.
  chemical constituents ←

ALGAE

- Chlorophyll bearing, Autotrophic
- Thalloid
- Largely aquatic → fresh water / marine (fam)
- Various other habitat → moist stones / soils / wood.
- Associations: → Fungi → Lichen / → Animals (Sloth, bear)

Form & Size: Highly Variable

- colonial → Volvox
- Filamentous → Ulothrix, Spirogyra
- Marine forms → Kelps (massive plant body)

Reproduction

Vegetative
By Fragmentation (fragment → thallus)

Asexual
Production of different types of spores.
Most common: Zoospores (motile) Flagellated
On germinat. → new

Sexual
By fusion of two gametes

- Isogam. → Flagell. → Ulothrix; non flagell. → Spirogyra
- Anisogam. → Ulothrix
- Oogam. → ♀ One large stationary, non motile × ♂ motile, small male gamete
  Eg. Volvox, Fucus

☆ Imp
Depending on ① type of pigment & ② type of stored food algae classified into three classes.
Red, Green, Brown algae

Uses:

- At least half of the total CO_2 fixation on earth is carried out by algae through photosynthesis.
  ↓
  They ↑ O_2 conc in the immediate surrounding.

* Chlorella, unicellular algae rich in protein used as food supplement even by space travellers

- Primary producers of (energy rich comp.): Forms the basis of life cycle of aquatic anim.
- Among 70 species of marine algae used as food → Laminaria, Sargassum, Porphyra, Sapola
- Certain marine, prod large amt of Brown algae → (algin) → used commercially → hydrocolloids (water holding subs)
  Red algae → (Carrageen) → Gelidium, Gracilaria → Agar → Used to grow microbes; Prepare ice creams & gellies

Chlorophyceae

Green Algae.

Chl. a & b (localised in definite chloroplast)
(grass green in colour)

Fresh water, Brackish water
Salt water

Store food : Oil droplet / starch.

Cell wall : Rigid, Outer - pectose
Inner - cellulose

Plant body : Unicellular
colonial filamentous

Chloroplast - Discoid, plate like, reticulate, cup shaped, spiral or ribbon shaped in diff species.
Most of members have one or more storage bodies pyrenoids in the chloroplast
↳ contain protein & starch

Vegetative Repr. - By fragmentation
OR
By diff types of spores

Asexual Repr - by flagellated zoospore produced in zoosporangia
2-8, apical equal

Sexual Repr - considerable variation in the type & formation of sex cells.
Isogam. Anisogam. Oogam.

Phaeophyceae

Brown algae. depending on the amt of xanthophyll, fucoxanthin

Chl. a & c, Carotenoids, Xanthophyll
(Vary in colour from olive green to various shades of brown)

Fresh water (rare), brackish water
Salt water (Primarily in marine habitats)

Protoplast contains, in addition to plastids centrally located vacuole & nucleus

Complex carbohydrate → Laminarin
→ Mannitol

Vegetative cells have a cellulosic wall, usually covered on outside by a gelatinous coating of algin.

They show great variation in size & form.
Range : Simple branched filamentous form (Ectocarpus) → to → profusely branched (Kelps - 100m high)

Attached to substratum by : holdfast
Stalk - stipe
Leaf like photosynth organ - frond

Vegetative Repr - By fragmentation

Asexual Repr - By ① biflagellated zoospore that are → ② Pear shaped. Two unequal, laterally attached flagella.
2 unequal, lateral

Sexual Repr - ① Isog. ② Anisog. ③ Oogam.

Fusion of gametes may take place → in water (external)
→ within oogonium in oogams; spec. (internal)
gametes are pyriform, two laterally attached flagella.

Rhodophyceae.

Red algae

Chl. a & d, R - phycoerethrin (red pigment)

Fresh water (some), brackish water
Salt water (most) ; Majority red algae : marine
Greater concentration in warmer areas, they occur in both → well light reg. → close to surface of water
→ dark / no light (relatively) penetrates → great depths in ocean.

Floridean starch (similar to amylopectin & glycogen in structure)

Cellulose, pectin, polysulphate esters.

The red thalli of most of the red algae are multicellular. Some of them have a complex body organisation.

Veg Repr By fragmentation

Asexual Repr - By non-motile spore

Sexual Repr - By non-motile gametes
↓
Only oogam. repr. occurs
↓
accompanied by complex post fertilization developments.

BRYOPHYTES

- Mosses
- Liverworts

Commonly grows in: moist shaded areas in the hills.

"Amphibians of the plant kingdom" because → They can live in soil but dependent on water for sexual reproduct.

Locations: Damp, humid & Shaded localities

★ Imp Role & Succession on bare Rocks/soil ★

Bryophyte body → more differentiated than the algae

- Thallus like
- Prostate
- Erect
- Attached to substratum by: Unicellular (Liverworts) / multicellular (Mosses) rhizoids

Unbranched / Branched rhizoids

Decomposer rocks: making substrate suitable for growth of higher plants.

Prevent erosion: Since mosses form dense mats on soil & reduce the impact of falling rain.

"They lack true roots, stems or leaves, but may possess "root-like", "leaf-like" or "stem-like" structures."

Main plant Body: Haploid & produce gametes → so called "Gametophyte".

"The sex organs in bryophytes are multicellular".

Male sex Organ: Antheridium → prod. biflagellate antherozoids

Female sex org.: Archegonium (Flask shaped) → prod. Single egg

Antherozoids + Single egg → Zygote

Zygote → It does not undergo reduction division immediately → produce → Multicellular body "sporophyte".

↳ Not free living but attached to the photosynth. gametophyte

Some cells of sporophyte → undergo meiosis → Haploid spores → germinate → Gametophyte

- Bryophytes in general of: Little economic importance
- Some mosses: Provide food for ① herbaceous mammals, ② birds & ③ other animals
- Some species of Sphagnum: Provide peat → Fuel, packaging mates. → transshipment of living material (bcz of their capacity to hold water)

* Mosses along with lichens are first organisms to colonise rocks & hence of great ecological importance.

LIVERWORTS

Location : Moist, Shady habitats → banks of streams, Marshy ground, damp soil, Bark of trees, deep in the woods

Plant body : Thalloid (eg. Marchantia)
(1) Dorsiventral
(2) Closely appressed to substrate.
* Leafy members have tiny leaf like appendages in two rows on stem-like structures.

Asexual Repr. → Fragmentation of thalli
OR
Formation of specialised str. called gemmae (sing. gemma) → haploid (N)
- Green
- Multicellular
- Asexual Buds
- Develop in the small receptacles → gemma cups → located on thalli

detached from parent body and germinate to new individ.

Sexual Repr. → Male & Female sex organs are produced on either same or different thalli.

Sporophyte → differentiated to Foot, Seta, Capsule

Capsule → spores → Germinate to give Free living gametophy.

After meiosis spores produced here

Isogam. Anisogam. Oogam.

Form two indefinite flagella.

MOSSES

Location : Moist, shaded areas.

Predominant stage of life cycle → Gametophyte

Two stages: Protonema, Leafy stage

Protonema
- Develops directly from spore
- Creeping
- Green
- Branched
- Frequently filamentous

Leafy stage
- Develops from sec protonema as Lateral bud.
- Upright
- Slender axes
- Bears spirally arranged leaves
- Rhizoids: Branched multicellular

This stage bears sex organs.

Eg. Funaria, Polytrichum, Sphagnum

Veget. Reproduction → By fragmentation & budding in sec. protonema

Sexual Repr. → At the apex of leafy shoot

* Sporophyte in mosses more elaborate than liverworts.
* Mosses have elaborate mechanism of spore dispersal.

antheridia, Archegonium

Zygote → develops into sporophyte

Foot, Seta, Capsule → contain Spo...

Peristome Teeth

PTERIDOPHYTES → horsetails, Ferns

Uses → medicinal purposes, soil-binders, Ornamentals.

* Evolutionary, they are first terrestrial plants possess vascular tissues – xylem & phloem.

Location: Cool, Damp, Shady Places
They may flourish well in sandy – soil conditions.

Main plant Body: Sporophyte
differentiated into
True → (Root, stem, Leaves) → These organs possess well differentiated vascular tissues.

Leaves: Small (microphylls) → Selaginella
Large (macrophylls) → Ferns

* Sporophytes → sporangia → subtended by a leaf like appendages → sporophylls

In some cases → Ferns ① distinct strobili/cones → Selaginella, Equisetum
② compact strobili/cones

meiosis in SMC → produce spores → germinate

multicell. ← M I S → Inconspic. / Small

Inconspicuous, small, multicellular, Free living, Mostly photosynth., Thallood → gametophyte "PROTHALLUS"

Free living ← Forgemost → mostly photosynthetic / Thalloid

Requires cool, damp, shady places to grow

Because of the specific restricted requirement and the need for water for fertilisation, the spread of living pteridophytes is limited and restricted to diverse geographical regions.

Water required → transfer of antherozoids → To mouth of archegonia

Gametophytes

♂ sex organ | bears | ♀ sex organ

Antheridia → ✕ ← Archegonia

↓

Zygote

↓

(dominant phase) Sporophyte (well differentiated multicellular)

MAJORITY → Homosporous

- Spores of similar kind

FEW → Heterosporous

Sellaginella, Salvinia

2 kinds of spores

Macro (~~Small~~ large) | Micro (small)

SMS → Marsilea

* Megaspore —germinate→ Female gametophyte
  Microspore —germinate→ Male Gametophyte.

" The female gametophyte in these plants are retained on the parent sporophyte for variable periods "

" The development of zygotes into young embryos take place within the female gametophytes. " This event is a precursor to the seed habit → imp step in evolution.

Psilopsida	Lycopsida	Sphenopsida	Pteropsida
↓	↓	↓	↓
Psilotum	Selaginella, Lycopodium	Equisetum	Dryopteris, Pteris, Adiantum

GYMNOSPERM

→ medium sized trees
→ tall trees
→ shrubs

Gymnos : naked. "Naked seeded plants"
sperma : seeds

"Ovules are not enclosed by any ovary wall & remain exposed before & after fertilization."

Post fertilized → seeds → not covered/naked.

Sequoia → one of the tallest tree species.
(Redwood tree)

(1) Roots : Generally tap roots

in generas (some) have fungal associations

Pinus
Mycorrhiza

Cycas
Small specialized coralloid roots are associated with N_2 fixing cyanobacteria.

(2) Stems :
→ Unbranched → cycas
Sunny → cycas → Unbranched
→ Branched → Pinus, Cedrus

(3) Leaves :
→ simple
→ compound.

→ Withstand temp
→ humidity
→ wind

Conifers
- needle like leaves
- Reduces surface area
- Thick cuticle
- sunken stomata
- Help reduce water loss

Cycas
Pinnate leaves → persists for a few years.

Gymnosperms → HETEROSPOROUS
- Microspore
- Megaspore

(Haploid)

"Prod. within sporangia that are borne on sporophylls."
↓
arranged spirally on the axis to form lax or compact strobili or cones.

Lax → sporophylls → sporangia

Strobili bearing
- microsporophylls & microsporangia → is called → Microsporangiate / Male strobili → microspore → this develops into male gametophyte — which is highly reduced & is confined to only a limited number of cells. → Reduced male gametophyte → pollen grain → microsporangia (their development takes place inside)
- megasporophylls with ovules or megasporangia → called → macrosporangiate / female ~~strobi~~ strobili

* "The male or female cones or strobili may be borne on same tree - Pinus".

* "In cycas, male cones and megasporophylls are born on diff. trees"

* Megaspore mother cell is differentiated from one of cells of nucellus (1 MMC) → meiosis → 4 megaspore → Only one megaspore enclosed within megasporangium develops into a multicellular female gametophyte that bears two or more archegonia / ♀ sex organ. The multicellular female gametophyte is retained within megasporangium.

Ovule ← born on megasporophylls, clustered to form female cones. ← protected by envelopes

Unlike bryoph. & pteridophy. → gymnosperm, the ♂ & ♀ gametophytes do not have INDEPENDENT FREE LIVING EXISTENCE. → "They remain within sporangia retained on sporophytes"

Pollen grain → Released from microsporangium → Carried by air currents → come in contact with the opening of ovules born on megasporophylls → Pollen tube carrying male gametes grows towards archegonia in the ovules → discharge their contents near mouth of archegonia → Fertilization → zygote → embryo → Ovules → seeds (not covered)

ANGIOSPERMS

Pollen grains & ovules → developed in → flowers (specialised structure)

- Seeds are enclosed in fruits
- exceptionally large gps
- wide range of habitats
- Size: Wolffia (smallest) to tall trees Eucalyptus (100 m high)
- Provide us: food, fodder, fuel, medicine 98.3 f, m → medicine

Classes

Dicots

- Seeds with two cotyledons.
- Reticulate venation
- Tetramerous / pentamerous flowers (4 or 5 members in each whorl)

Monocots

- seeds with single cotyledon
- Parallel venation
- Trimerous

fuel food fodder

Male sex organ: Stamen → slender filament → anther at tip.

Within these → PMC → meiosis → microspore → mature pollen grain

Female sex organ: Pistil → ovary → at base → ovules are present

→ long slender style

→ stigma

each ovule → has Megaspore mother cell → meiosis → 4 haploid megaspore

Three degenerate, One of them divide → embryo sac

embryo sac → 3 cells/egg apparatus → one egg cell + two synergids

embryo sac → 3 antipodal cells

embryo sac → Two polar nuclei

Polar nuclei eventually fuse to produce a diploid secondary nucleus.

Pollen grains after disposal from anthers → carried by wind or various other agencies. → To stigma of pistil

↓

Resulting pollen tube grows through the tissues of stigma & style & reach ovule

↓

Pollen tubes enter the embryo sac where two male gametes are discharged.

one male gamete → egg cell → syngamy

other male gamete → Diploid sec. nucleus → Triploid primary Endosperm nucleus (PEN) (Triple fusion)

DOUBLE FERTILIZATION (unique to angiosperm)

Zygote → embryo (with 1/2 cotyledons)

PEN → endosperm (Provide nourishment to developing embryo)

Synergids & Antipodals → degenerate after fertilization

Ovule → seeds

Ovaries → fruit

ALTERNATION OF GENERATIONS

* In plants, both haploid & diploid cells can divide by mitosis. This ability leads to formation of different plant bodies — haploid & diploid.
  - haploid → produce gametes by mitosis
  - diploid → produce spores by meiosis → germination by mitosis → To form haploid plant body.

* There is an alternation of generations b/w gamete producing haploid gametophyte & spore producing diploid sporophyte.

HAPLONTIC → Many algae as volvox, Spirogyra
Some species of chlamydomonas

* Sporophytic Generation is represented only by one celled zygote
* No free living sporophytes
* Meiosis in Zygote → haploid spores mitotically → gametophyte (Dominant, Free living Photosynthetic)

DIPLONTIC → Gymno & Angio, With some variations; An alga — Fucus sp.

* Diploid sporophyte → Dominant, Independent / free living Photosynthetic

* Gametophyte is represented by single to few celled (multi celled) haploid gametophyte.

HAPLODIPLONTIC → Both the phases – multicelled.

	Bryophytes	Pteridophytes
Gametophyte (n) →	Dominant Independent Photosynthetic Thalloid Erect	Multicelled Saprophytic/Autotrophic Independent Short lived
Sporophyte →	Short lived multicelled Partially or totally dependent on gametophyte for anchorage, nutrition	Dominant Independent photosynthetic Vascular

Algae → Ectocarpus, Polysiphonia, Kelps.